Psychological Assessment
2004, Vol. 16, No. 3, 255–266

1040-3590/04/$12.00 DOI: 10.1037/1040-3590.16.3.255

Construct Validity of the Posttraumatic Stress Disorder Checklist in Cancer Survivors: Analyses Based on Two Samples

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The measurement of posttraumatic stress disorder (PTSD) is critically important for the identification and treatment of this disorder. The PTSD Checklist (PCL; F. W. Weathers & J. Ford, 1996) is a self-report measure that is increasingly used. In this study, the authors investigated the factorial validity of the PCL with data from 236 cancer survivors who received a bone marrow or stem cell transplantation. The authors examined the fit of these data with the clinical model of 3 symptom clusters for PTSD, as proposed in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; American Psychiatric Association, 1994), and alternative models tested in prior research. By using confirmatory factor analysis the authors found that a 4-first-order-factor model of PTSD provided the best fit. The relations of PTSD symptoms with sociodemographic and medical variables were also explored.

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This work was supported by American Cancer Society Awards RSGPB-02-228-01-PBP and RPG-99-271-01-PBP. Katherine N. DuHamel's work was also supported by U.S. Army Medical Research and Material Command Award DAMD17-99-1-9304. The views, opinions, and/or findings contained in this document are those of the authors and should not be construed as an official Department of the Army position, policy, or decision unless so designated by other documentation. William Redd's work was also supported by National Institute of Mental Health Award MH-01900, Elizabeth A. Mundy's and Karen Hurley's work was also supported by National Cancer Institute Award CA-81137-05, and Jack Burkhalter's and Rosy Chhabra's work was also supported by the National Cancer Institute Award T32-CA09461.

We thank the bone marrow and stem cell transplant survivors who participated in this study. We also acknowledge the contributions of Justin Michener, Christine Rini, Julian Silva, Dana Spencer, and Dorothy Parks, for their assistance in manuscript preparation.

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Unfortunately, many people are exposed to a traumatic event in their lifetime. For the noninstitutionalized civilian population in the United States, the lifetime prevalence of trauma exposure has been estimated at 60.7% for men and 51.2% for women (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). Exposure to a traumatic event can lead to a psychiatric diagnosis of posttraumatic stress disorder (PTSD). As specified in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–IV;* American Psychiatric Association, 1994), PTSD is an anxiety disorder that can occur when a person is exposed to an event that is life threatening to self or others and feels intense fear, helplessness, or horror. PTSD is characterized by three symptom clusters: (a) reexperiencing of the trauma, such as having intrusive thoughts (Cluster B); (b) avoidance/numbing of general responsiveness, such as engaging in avoidance behaviors (Cluster C); and (c) increased arousal, such as having difficulty staying asleep (Cluster D). For a diagnosis of PTSD to be made, the individual has to report one or more reexperiencing symptoms, three or more avoidance/numbing symptoms, and two or more arousal symptoms. The symptoms have to be present for more than 1 month and cause significant distress or impairment in important areas of functioning. Effective treatments have been developed to reduce the symptoms of PTSD (e.g., cognitive–behavioral intervention that includes exposure to the cues that the person avoids and pharmacotherapy such as antidepressants). Assessment of PTSD identifies individuals likely to benefit from such treatments and also has important implications for access to care and insurance reimbursement (Ruscio, Ruscio, & Keane, 2002).

Investigators have used two methods for assessing PTSD in various adult trauma populations: structured clinical interviews (e.g., Structured Clinical Interview for *DSM–IV* [SCID], PTSD module; First, Spitzer, Gibbon, & Williams, 1997) and self-administered questionnaires (e.g., the PTSD Checklist [PCL]; Weathers & Ford, 1996). Although clinical interviews are considered to be the gold standard, self-report questionnaires are easy to administer, time efficient, and commonly used. One such measure, the PCL, consists of 17 items that correspond to the *DSM*'s symptoms of PTSD. The PCL has been used in a variety of trauma populations, including survivors of motor vehicle accidents (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996) and combat (Weathers & Ford, 1996). Widely used measures such as the PCL need to be critically evaluated to ensure that they are measuring the construct that they were designed to measure. Watson (1990) developed five criteria for comparing and evaluating measures of PTSD. A measure should (a) correspond to the contemporary criteria of the *DSM,* (b) possess robust reliability, (c) have established validity as determined by its association with already valid measures (i.e., criterion validity), (d) generate both dichotomous (indicating the presence or absence of the disorder) and continuous (indicating the severity) outputs, and (e) be designed for administration by trained nonprofessionals.

The PCL meets Watson's (1990) five criteria. It was developed to match the PTSD symptoms outlined in the *DSM,* and it is reliable and valid (Weathers & Ford, 1996). Several studies have compared the PTSD diagnosis based on the PCL to the assessment of PTSD with clinical structured interviews such as the SCID and the Clinician-Administered PTSD Scale (CAPS; Blake et al., 1990). In four out of the six validity studies reviewed, the PCL had good specificity, ranging from 0.83 to 0.99, and sensitivity, ranging from 0.60 to 0.82 (Andrykowski, Cordova, Studts, & Miller, 1998; Blanchard et al., 1996; Forbes, Creamer, & Biddle, 2001; Manne, DuHamel, Gallelli, Sorgen, & Redd, 1998; Stein, McQuaid, Pedrelli, Lenox, & McCahill, 2000; Weathers, Litz, Herman, Huska, & Keane, 1993). Scoring of the PCL generates a dichotomous and continuous output, and trained nonprofessionals can administer it.

An additional criterion for measures that is noted by the American Educational Research Association, American Psychological Association, and National Council on Measurement in Education (1999) is that the rationale and evidence for the specific scores and score combinations (i.e., internal structure of the test) should be provided. In the traditional nomenclature, this is called *factorial validity* and is one aspect of construct validity (Anastasi, 1988). If the PCL has good factorial validity, factor analysis should result in the *DSM–IV* hierarchical model of PTSD: three factors reflective of the three symptom clusters, called *first-order factors,* which should be subsumed under a larger, unitary factor, called a *second-order factor*.

The results for factorial validity of the PCL in prior research have been mixed (e.g., L. A. King, King, Fairbank, Keane, & Adams, 1998). As noted by prior researchers (e.g., Cordova, Studts, Hann, Jacobsen, & Andrykowski, 2000), one reason for the inconsistent findings may be that the procedures for establishing the PCL's factor structure have included both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). In contrast to EFA, CFA is theory and hypothesis driven. Several studies have examined the factorial validity of the PCL using the preferred method of CFA. For example, five alternative models of PTSD with CFA were tested in patients presenting for medical problems: a 3-first-order-factor model, a 4-first-order-factor model, a 4-first-order-factor model with 1 second-order factor, a 3-first-order-factor model with 1 second-order factor, and a 2-first-order-factor model (Intrusion/Avoidance and Arousal/Numbing) with 1 second-order factor (Asmundson et al., 2000). The four-factor model with Reexperiencing, Avoidance, Numbing, and Arousal all subsumed by a second-order factor of PTSD provided the best fit for the data. As noted by Asmundson and colleagues (2000), this finding is consistent with prior research by King and colleagues (D. W. King, Leskin, King, & Weathers, 1998), who found support for a first-order model with four clusters of PTSD with data from the CAPS. Support for four dimensions of PTSD and a second-order factor has also been found with a different self-report measure, the Mississippi Scale (L. A. King & King, 1994). Despite these similarities in prior research, the lack of congruence with the *DSM–IV* model in Asmundson and colleagues' study could be due to the fact that participants were patients presenting at a medical clinic with routine medical problems. Furthermore, the stressor was not specified, and thus it is unclear if it involved actual or threatened death or serious injury, as required in the *DSM–IV.*

The present study builds on the study by Asmundson and colleagues (2000), as well as other prior research, by testing multiple models of the symptom structure of the PCL with cancer survivors who had received a bone marrow or stem cell transplantation (BMT/SCT) during their course of treatment. Although BMT/SCT has led to better prognosis and survival rates for adults with diseases such as hematological malignancies and solid tumors (Geller et al., 1997), it involves a threat to one's life, it is recognized as one of the most aversive of cancer treatments, and it is associated with substantial morbidity and mortality (Andrykowski, 1994; Andrykowski, Bruehl, Brady, & Henslee-Downey, 1995;

Lesko, 1993; Syrjala, Chapko, Vitaliano, Cummings, & Sullivan, 1993). Two prior studies investigated the factor structure of the PCL with data from cancer survivors, some of whom had received a BMT/SCT. The first study was conducted with cancer survivors who had all received a BMT/SCT (Smith, Redd, DuHamel, Vickberg, & Ricketts, 1999).[1] Using EFA, Smith et al. (1999) found a 4-first-order-symptom cluster of PTSD: (a) numbing–hyperarousal, (b) dreams–memories of the cancer treatment, (c) general hyperarousal, and (d) responses to cancer-related reminders and avoidance/numbing.

These data were inconsistent with the *DSM–IV* model of PTSD, and they were difficult to interpret because of cluster items not clearly loading together on one factor (e.g., one arousal item, "Feeling irritable or having angry outbursts," loaded with four numbing items, two arousal items loaded on their own cluster, and two arousal items did not load on any factor). These results could have been due to the small sample size or the analytic approach (EFA rather than CFA). In a second study, Cordova and colleagues used CFA with a larger sample of breast cancer survivors, some of whom had received a BMT/SCT (Cordova et al., 2000). Their results supported the *DSM–IV* model but also suggested that Avoidance and Numbing might be two separate factors, which would yield a four-factor solution. However, they did not compare the fit of the *DSM–IV* model to a four-factor model. These studies indicate the need to test the fit of *DSM–IV*'s PTSD symptom cluster model and other PTSD symptom cluster models in cancer survivors.

The aim of this study was to investigate the factorial validity of the PCL with a relatively large sample of cancer survivors, all of whom had received a BMT/SCT. On the basis of the measurement models examined in prior research (Asmundson et al., 2000) with the PCL in medical patients, we tested seven models of PTSD (see Figure 1). We tested four models of PTSD with first-order factors: a single-factor model of PTSD (Model 1), a 2-first-order-factor model of PTSD (Model 2), a 3-first-order-factor model of PTSD (Model 3), and a 4-first-order-factor model of PTSD (Model 4). Next, we tested three hierarchical factor models of PTSD: 2 first-order factors (Reexperiencing/Avoidance and Numbing/Arousal) subsumed under 1 second-order factor (Model 5), 3 first-order factors (Reexperiencing, Avoidance/Numbing, and Arousal) subsumed under 1 second-order factor (Model 6), and 4 first-order factors (Reexperiencing, Avoidance, Numbing, and Arousal) subsumed under 1 second-order factor (Model 7). On the basis of the *DSM–IV* criteria, we hypothesized that the model with 3 first-order factors and 1 second-order factor would provide the best fit with the data. To the best of our knowledge, ours is the first study to investigate multiple models for the symptom structure of PTSD as measured by the PCL with a large number of cancer survivors who have all experienced a BMT/SCT.

We also explored the relations of sociodemographic and medical treatment variables with PTSD symptoms. On the basis of prior research, we expected that cancer survivors with higher levels of PTSD symptoms would be younger, not married, female, less educated, and have a lower income (e.g., Kessler et al., 1995; D. W. King, King, Foy, & Gudanowski, 1996; Wolfe, Erickson, Sharkansky, King, & King, 1999). On the basis of prior research with cancer patients (e.g., Andrykowski et al., 1998), we also explored the possibility that PTSD symptoms would be associated with two medical indicators: time since treatment completion and type of transplant (autologous [stem or marrow cells from the self] vs. allogeneic [stem or marrow cells from a donor]).

Method

Participants

Data for the present study represent the combination of data from a sample of 110 cancer survivors from a prior study (Sample 1; Smith et al., 1999) and a sample of 126 cancer survivors (Sample 2), resulting in 236 participants, all of whom had received a BMT/SCT. Combining data was deemed an appropriate way to generate a large enough sample size to test the alternative models of PTSD symptoms with CFA, as was recommended by prior researchers (Marsh & Hau, 1999). Participants from Sample 1 were BMT/SCT recipients at a large comprehensive cancer center. Eligibility criteria included that the individuals (a) were 16 years of age or older when the BMT/SCT was performed, (b) were at least 6 months post-BMT/SCT, and (c) spoke English. Information about the participants from Sample 1 can be found elsewhere (Smith et al., 1999). Participants from Sample 2 were BMT/SCT recipients who were being screened for possible participation in a pilot intervention trial of cognitive–behavioral therapy (CBT) designed to reduce PTSD symptoms in cancer survivors at either the same comprehensive cancer care center as Sample 1 or an urban medical center. Eligibility criteria for Sample 2 included that individuals (a) were 18 years or older; (b) were 1 or more years post-BMT/SCT, and (c) spoke English. Of the 177 individuals who met the criteria, 25 could not be located, 5 were located but were unable to arrange an interview time, and 21 refused to participate, which resulted in 126 participants who provided informed consent and participated. Individuals from Sample 2 who participated did not differ from those who refused on sociodemographic or treatment-related variables (i.e., gender, age at interview, age at BMT/SCT, type of transplantation, and time since BMT/SCT).

Information about the 236 individuals included in this study is presented in Table 1. Most participants were White (78%) and well educated (76% had some college, a college degree, or post-college credits). At the time of the interview, respondents' mean age was 41.7 years ($SD = 11.6$, range = 18–69 years), and they had undergone BMT/SCT on average 3 years prior to assessment (range = 6 months to 11.5 years).

Procedures

This study was conducted as part of a larger ongoing effort to assess the psychological adjustment, quality of life, and PTSD symptoms in adult cancer survivors who had received a BMT/SCT. Sample 1 included participants from a cross-sectional telephone interview study that represented our initial efforts in this area. As previously noted, Sample 2 included a new group of 126 cancer survivors. The recruitment procedures for Sample 2 were similar to those for Sample 1. For both samples, eligible cancer survivors were mailed a letter that described the study. A packet of measures was mailed in advance of the telephone assessment. A research team member who was not involved in patients' medical care interviewed those individuals who were interested in participating and who provided consent. The validity of using telephone interviews has been previously supported (e.g., Dansky, Saladin, Brady, Kilpatrick, & Resnick, 1995; Rohde, Lewinsohn, & Seeley, 1997).

Measures

Participants completed a battery of measures, one of which, the PCL, is relevant to this study (Weathers & Ford, 1996). Sociodemographic and

[1] Study participants were primarily diagnosed with leukemia. Throughout this article, the word *cancer* is used to refer to the diagnosis of cancer and related disorders.

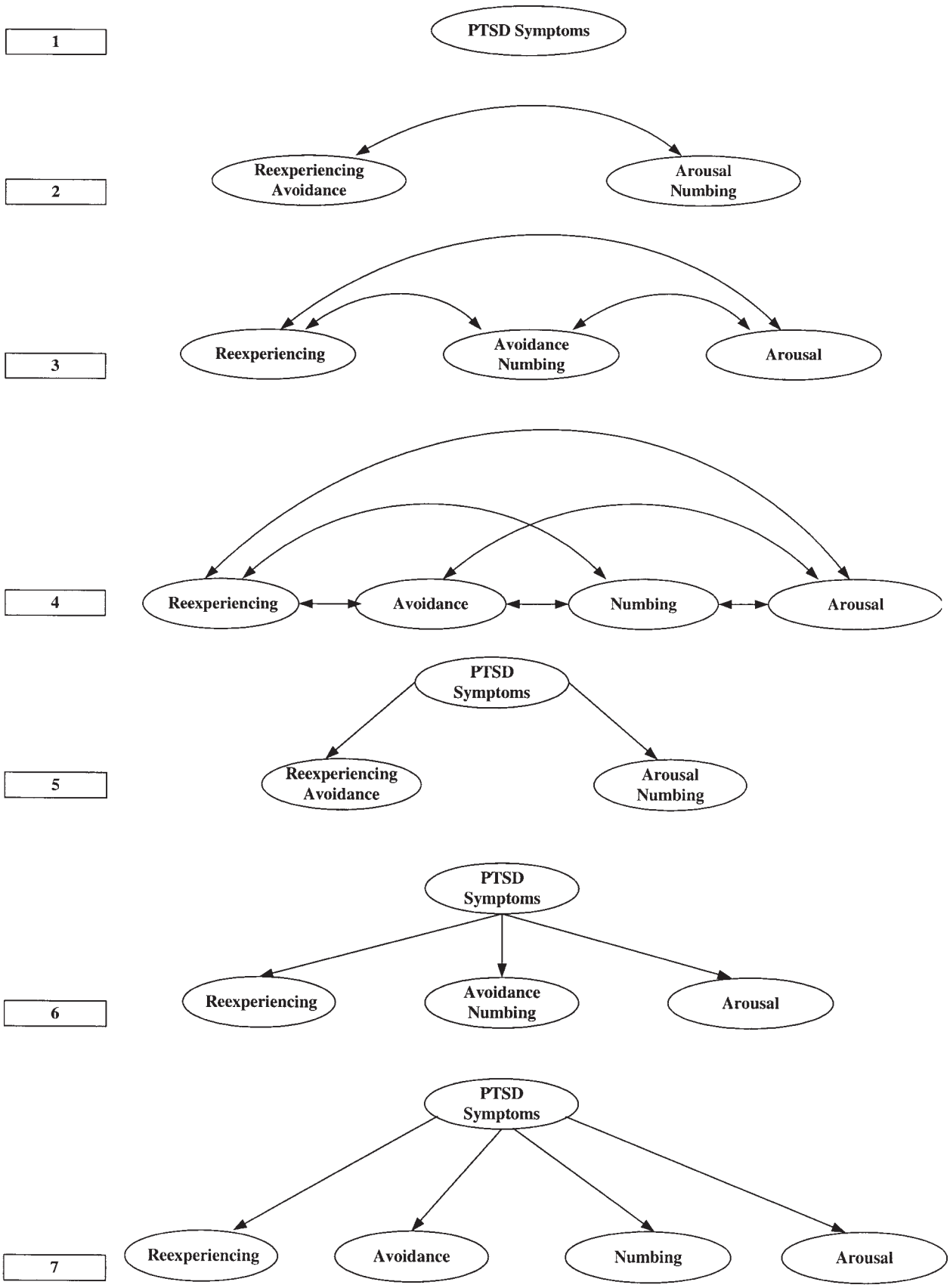

Figure 1. Posttraumatic stress disorder (PTSD) symptom cluster models.

Table 1
Demographic Information of Participants

Variable	Sample 1: $n = 110$	Sample 2: $n = 126$	Total sample: $N = 236$
Gender			
Female	54 (49.1)	53 (42.1)	107 (45.3)
Male	56 (50.9)	73 (57.9)	129 (54.7)
Race			
White	85 (77.3)	100 (79.4)	185 (78.4)
Black	6 (5.5)	9 (7.1)	15 (6.4)
Hispanic	10 (9.1)	7 (5.6)	17 (7.2)
Asian	6 (5.5)	2 (1.6)	8 (3.4)
West Indian		2 (1.6)	2 (0.8)
Other		5 (4.0)	5 (2.1)
Don't know/refused/missing	3 (2.7)	1 (0.8)	4 (1.7)
Education			
$\leq$ 12 years	25 (22.7)	32 (25.4)	57 (24.2)
Some college or college degree	66 (60.0)	62 (49.2)	128 (54.2)
Post-college or advanced degree	19 (17.3)	32 (25.4)	51 (21.6)
Employment status			
Employed	75 (68.2)	77 (61.1)	152 (64.4)
Not employed	35 (31.8)	49 (38.9)	84 (35.6)
Income			
$25,000 or less (Sample 1)	22 (20.0)		
$19,999 or less (Sample 2)		16 (12.7)	
$25,000–$50,000 (Sample 1)	34 (30.9)		
$20,000–$59,000 (Sample 2)		45 (35.7)	
$50,000 or more (Sample 1)	49 (44.5)		
$60,000 or more (Sample 2)		50 (39.7)	
Missing/not indicated (Sample 1)	5 (4.5)		
Missing/not indicated (Sample 2)		15 (11.9)	
Cancer diagnosis			
Chronic leukemia	42 (38.2)	22 (17.5)	64 (27.1)
Acute leukemia	42 (38.2)	20 (15.9)	62 (26.3)
Lymphoma	6 (5.5)	53 (42.1)	59 (25.0)
Anemia/blood disorder	13 (11.8)	9 (7.1)	22 (9.3)
Other cancers	7 (6.4)	22 (17.5)	29 (12.3)
Type of transplant			
Allogeneic	103 (93.6)	52 (41.3)	155 (65.7)
Autologous	7 (6.4)	74 (58.7)	81 (34.3)
Main partner			
Has a partner	80 (72.7)	101 (80.2)	181 (76.7)
No partner	30 (27.3)	24 (19.0)	54 (22.9)
Missing/not indicated		1 (0.8)	1 (0.4)
Marital status			
Never married	37 (33.6)	35 (27.8)	72 (30.5)
Married	62 (56.4)	76 (60.3)	138 (58.5)
Separated	2 (1.8)	5 (4.0)	7 (3.0)
Divorced	6 (5.5)	6 (4.8)	12 (5.1)
Widowed	2 (1.8)	4 (3.2)	6 (2.5)
Other	1 (0.9)		1 (0.4)
Age at interview			
$M \pm SD$	39.5 $\pm$ 10.6	43.6 $\pm$ 12.1	41.7 $\pm$ 11.6
Range	18.2–59.5	18.9–69.9	18.2–69.9
Years since BMT/SCT			
$M \pm SD$	4.1 $\pm$ 2.8	2.8 $\pm$ 1.6	3.4 $\pm$ 2.3
Range	0.6–11.5	1.1–8.9	0.6–11.5

Note. All values except those for age at interview and years since BMT/SCT are numbers of participants (with percentages of relevant sample). BMT = bone marrow transplantation, SCT = stem cell transplantation.

medical information (e.g., type of transplant) were obtained from the study participants and from their hospital records.

The PCL is a 17-item self-report measure developed to assess PTSD symptoms,[2] and the civilian version of the instrument was used in the study. Participants used a 5-point Likert scale (1 = *not at all,* 2 = *a little bit,* 3 = *moderately,* 4 = *quite a bit,* and 5 = *extremely*) to rate the extent to which they had been bothered in the past month by 17 symptoms of PTSD based on the *DSM–IV* symptom clusters: reexperiencing, avoidance/numbing, and arousal. Questions were keyed to cancer (e.g., "How much have you been bothered in the past month by . . . repeated, disturbing memories of the cancer and its treatment?"). Weathers et al. (1993) suggested that a symptom should be considered as meeting the threshold

[2] The PCL is available from the National Center for PTSD at http://www.ncptsd.org.

criterion if an individual reports that it has bothered him or her moderately, quite a bit, or extremely (i.e., an item endorsement of 3 or greater on the Likert scale). Summing of the threshold items indicates whether the person meets the criteria for each of the *DSM–IV* symptom clusters (i.e., one or more reexperiencing symptoms [of 5 items representing Cluster B], three or more avoidance/numbing symptoms [of 7 items representing Cluster C], and two or more arousal symptoms [of 5 items representing Cluster D]).

If a person meets each symptom cluster's criteria, he or she meets *DSM–IV* symptom criteria for PTSD. PCL items can also be summed to generate a total PTSD symptom score. A cutoff score of 50 is also recommended as an indicator of PTSD. Two participants from Sample 2 were missing one data point on the PCL, and the mean cluster score was substituted for their missing data. Cronbach's alphas for the PCL total and *DSM–IV* subscale scores (Reexperiencing, Avoidance/Numbing, and Arousal) were .88, .74, .75, and .77, respectively.

Results

Analytic Strategy

Analyses were conducted in three stages. First, assessment of the appropriateness of combining the two samples was conducted. Second, the fit of hypothesized PTSD symptom models suggested by prior research was conducted with confirmatory factor analysis (Byrne, 1998) through the use of the program LISREL 8.30 (Joreskog, Sorbom, du Toit, & du Toit, 2000). The variance–covariance matrix of the individual items was used in these analyses. Finally, univariate analyses were used to investigate the relations of PTSD symptoms with sociodemographic and medical variables.

Appropriateness of Combining the Two Samples

Appropriateness of combining these two samples was assessed by investigation of possible differences in PCL mean scores and distributions. The mean PCL total scores of the two samples used in this study did not differ ($M = 28.75$ vs. $M = 27.78$), $t(234) = 0.76$, $p = .45$. The PCL total scores for both samples as well as the combined one were not skewed but were kurtotic (Sample 1, skewness = 1.61, kurtosis = 3.61; Sample 2, skewness = 1.42, kurtosis = 2.79; combined sample, skewness = 1.56, kurtosis = 3.49; Tabachnick & Fidell, 1996). (Kurtotic items are discussed below.) On the basis of these statistics, the two samples were judged to be comparable and were combined for study analyses. However, we conducted additional analyses to further estimate the comparability of the two samples. The confirmatory factor analysis results described below with the best fitting model (Model 4) were reanalyzed with the pooled within-groups variance–covariance matrix (i.e., the average variance–covariance matrix for the two groups). This variation of Model 4 was labeled Model 4A.

Investigation of Models of PTSD

First, we generated the descriptive statistics for the PCL. Second, to address the aim of the study, we tested the fit of the symptom structure of PTSD symptoms in the present sample with the hypothesized models. Finally, we conducted analyses comparing the fit of alternative PTSD symptom models.

Descriptive statistics indicated that the means for the PCL total and subscale scores for Reexperiencing, Avoidance/Numbing, and Arousal were 28.2 ($SD = 9.9$, range = 17–78), 7.4 ($SD = 2.8$, range = 5–21), 11.8 ($SD = 4.7$, range = 7–34), and 9.1 ($SD = 3.9$, range = 5–25), respectively. Table 2 contains the item-descriptive statistics. Although most of the items were reasonably normally distributed, there were four items with kurtosis in the range of 4–6 (Item B3, reliving the cancer experience; Item B5, having physical reactions; Item C2, avoiding activities or situations; and Item C6, feeling emotionally numb or unable to have loving feelings). One item was quite kurtotic (Item B2, repeated, disturbing dreams; kurtosis = 18.42). These items were winsorized (on the 5-point scale for these items, individuals scoring 4 or 5 were assigned a score of 3; Tukey, 1977), and the resulting kurtosis for four items was less than 2.00. One item (B2) remained kurtotic (kurtosis = 6.70). Given that after the data were winsorized 16 of 17 items were not kurtotic, we deemed that these data (with the winsorized items) were appropriate for structural equation modeling. Furthermore, maximum-likelihood estimates such as those used in the present study are robust to moderate violations of normality (Chou & Bentler, 1995). The results of the correlational analyses for the 17 PCL items with the winsorized items (transformed data) are presented in Table 2.

Using the transformed data, we investigated the fit of the alternative hypothesized models with the participants' data on the PCL. One of the most commonly used measures of the overall fit of a model is the chi-square test, which indicates whether there is a difference between a hypothesized model and the data (Joreskog et al., 2000). A good fit between the hypothesized model and the data is indicated when the chi-square is not significant. However, current recommendations suggest augmenting the chi-square test by reporting multiple fit indicators (Bollen & Long, 1993). Following these recommendations, we report the fit indicators used in prior research that assessed the factor structure of PTSD symptoms: the chi-square goodness of fit (Joreskog et al., 2000), the root-mean-square error of approximation (RMSEA; Browne & Cudek, 1993), the standardized root-mean-square residual (SRMSR), the nonnormed fit index (Bentler & Bonnett, 1980), and the comparative fit index (CFI; Bentler, 1990). For the various fit indices, values equal to or greater than .90 were generally taken to indicate good fit, as was a RMSEA of .00 to .08 and a SRMSR less than or equal to .05 (Joreskog et al., 2000).

The seven hypothesized models illustrated in Figure 1 were tested, and Table 3 summarizes the fit indices for both first-order and second-order models. (The variation of Model 4 using the pooled variance–covariance matrix for the two groups, Model 4A, was also tested, and the fit indices are reported in Table 3.) The results indicate that on all fit indices, Model 4 fits the data considerably better than the other first-order models. A more formal test involves the use of chi-square differences between Model 4 and Model 1, $\chi^2_{diff}(6, N = 236) = 166.52$, $p < .01$; Model 4 and Model 2, $\chi^2_{diff}(5, N = 236) = 101.93$, $p < .01$; and Model 4 and Model 3, $\chi^2_{diff}(3, N = 236) = 71.76$, $p < .01$. The significant difference tests indicated that Model 4 provided the best fit. Comparison of Model 4 and Model 7 indicated that Model 4 provided the better fit, $\chi^2_{diff}(1, N = 236) = 5.57$, $p < .05$. A chi-square difference test between Model 6 (the *DSM–IV* model) and Model 7 is not possible because these models are not nested. The Akaike information criterion (AIC; Akaike, 1974), however, indicated that Model 7 represented a better fit than Model 6 (AIC = 286.98 vs. 349.17, respectively). The AIC measure for a comparison of Model 4 to Model 6 also indicated that Model 4 fit better than Model 6 (AIC = 283.41 vs. 349.17, respectively). These results indicate that Model 4 provided the best fit with the

Table 2
Descriptive Statistics and Correlation Matrix of PCL Items (N = 236)

DSM–IV symptom	*M*	*SD*	Skew	Kurt	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5	C6	C7	D1	D2	D3	D4	D5
B1. Intrusive recollections	1.60	0.83	1.41	1.67	—																
B2. Distressing dreams	1.20	0.59	3.95	18.42	.441	—															
B3. Flashbacks to cancer	1.41	0.74	2.14	4.90	.329	.280	—														
B4. Distress at reminders	1.78	1.04	1.29	0.88	.547	.292	.266	—													
B5. Reaction to reminders	1.36	0.76	2.37	5.81	.421	.266	.334	.524	—												
C1. Avoid thoughts/feelings	1.54	1.04	1.94	2.66	.365	.212	.236	.339	.382	—											
C2. Avoid reminders	1.39	0.89	2.46	5.42	.362	.225	.369	.401	.478	.587	—										
C3. Psychogenic amnesia	1.90	1.14	1.08	0.02	.253	.228	.224	.279	.314	.246	.372	—									
C4. Anhedonia	1.71	1.10	1.44	0.98	.283	.292	.234	.355	.245	.250	.263	.322	—								
C5. Detached from others	1.66	1.02	1.55	1.57	.182	.151	.300	.327	.221	.149	.330	.353	.428	—							
C6. Psychic numbing	1.40	0.88	2.51	6.00	.276	.235	.236	.330	.261	.247	.343	.262	.405	.508	—						
C7. Foreshortened future	2.17	1.24	0.74	−0.64	.397	.178	.400	.310	.250	.204	.215	.153	.278	.281	.314	—					
D1. Disturbed sleep	1.99	1.32	1.10	−0.12	.337	.143	.229	.232	.190	.158	.298	.186	.230	.228	.380	.348	—				
D2. Irritability/anger	1.89	1.03	1.09	0.30	.358	.202	.327	.368	.308	.246	.329	.260	.457	.381	.339	.351	.330	—			
D3. Concentration difficulties	1.93	1.09	1.00	0.03	.276	.184	.196	.294	.288	.263	.333	.354	.344	.322	.425	.304	.496	.444	—		
D4. Hypervigilance	1.70	1.04	1.42	1.12	.297	.155	.305	.281	.254	.199	.305	.240	.284	.411	.329	.263	.349	.323	.341	—	
D5. Exaggerated startle	1.60	0.96	1.63	2.03	.297	.247	.272	.325	.324	.185	.369	.241	.281	.339	.284	.297	.370	.514	.444	.426	—

Note. B1–D5 are *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV*) cluster letters and item numbers. PCL = Posttraumatic Stress Disorder (PTSD) Checklist; Skew = item skewness; Kurt = item kurtosis.

data. As illustrated in Table 3, the use of the pooled variance–covariance matrix for the two groups did not change these conclusions (see the results of Model 4A vs. Model 4). These results also indicate that Model 6 (the *DSM–IV* model) did not provide a good fit (e.g., the RMSEA was .08, and the CFI was less than .90).

Analyses with the best fitting model, Model 4, resulted in factor loadings from .22 to .76. The standardized factor loadings and standard errors are reported in Table 4. Most standardized loadings are greater than or equal to .43 with the exception of "Distressing dreams" and "Flashbacks to cancer," indicating that they may not be the best items for the Reexperiencing factor in this sample. The correlations among the factors ranged from .57 to .84.

PTSD Symptoms Based on the DSM–IV and the Four-Symptom Cluster Model (Model 4)

The frequency of PTSD symptoms for the *DSM–IV* model and Model 4 were investigated (all subsequent analyses were conducted with the untransformed data). On the basis of the *DSM–IV* three-symptom cluster model, 26 participants (11%) were indicated as meeting criteria. On the basis of Model 4, Cluster C is divided into two factors, Avoidance and Numbing, resulting in the four-symptom cluster model. To reduce the risk of false negatives, for the four-symptom cluster model we required that participants endorse one symptom of avoidance and one symptom of numbing as well as meet the symptom requirement for the *DSM–IV*'s Clusters B and D. On the basis of this model, 17 participants (7.2%) met the criteria.[3] One of the participants who did not meet the three-symptom cluster criteria met the four-symptom cluster criteria, because he or she endorsed only one symptom of avoidance and one symptom of numbing when three Cluster C symptoms are required for the *DSM–IV* criteria. Fifty-one participants (21.6%) met *DSM–IV* Cluster C criteria. However, when the four-symptom cluster approach was taken, 41 participants (17.4%) from the entire sample met the criteria for avoidance and 125 participants (53.0%) met the criteria for numbing. Thus, numbing symptoms were much more frequent. Using the four-symptom cluster criteria, we found that 10 participants who met criteria for the *DSM–IV* PTSD clusters on the PCL were not identified because they did not report symptoms of avoidance. Overall, 27 participants (11.5%) met either the three- or the four-symptom cluster criteria.

A total score of 50 or greater on the PCL is also an indication that a person is likely to meet a diagnosis of PTSD. Using a cutoff score of 50 on the PCL, we did not identify any participants who were not already identified using the three-symptom cluster criteria. However, we identified two participants who did not meet the four-symptom cluster model. These two participants met the *DSM–IV* three-symptom cluster criteria. Thus, we identified 19 participants (8.1%) who met the criteria for PTSD using the four-symptom cluster model or a total PCL score of 50 or greater. One participant who met the four-symptom cluster criteria and not

[3] The four-symptom cluster model includes one Cluster C symptom less than that required in the *DSM–IV* (i.e., one symptom of avoidance and one of numbing). However, if we had required one symptom of avoidance and two symptoms of numbing, we would have identified fewer individuals meeting criteria (15 vs. 17). The number of clusters and symptoms requirement is an area for further research.

Table 3
Goodness-of-Fit Indices for the PTSD Models (N = 236)

Model	χ^2	*p*	*df*	RMSEA	SRMSR	NNFI	CFI
1	369.93	<.01	119	.095	.069	.78	.81
2	305.34	<.01	118	.082	.066	.82	.84
3	275.17	<.01	116	.076	.062	.84	.86
4	203.41	<.01	113	.058	.053	.90	.92
4A	201.57	<.01	113	.058	.053	.90	.92
5	305.34	<.01	118	.082	.066	.82	.84
6	275.17	<.01	116	.076	.062	.84	.86
7	208.98	<.01	114	.060	.055	.90	.92

Note. Model 1 = 1 first-order factor; Model 2 = 2 first-order factors; Model 3 = 3 first-order factors; Model 4 = 4 first-order factors; Model 4A = 4 first-order factors (with the pooled variance–covariance matrix for the two groups); Model 5 = 2 first-order factors and 1 second-order factor; Model 6 = 3 first-order factors and 1 second-order factor; Model 7 = 4 first-order factors and 1 second-order factor. RMSEA = root-mean-square error of approximation; SRMSR = standardized root-mean-square residual; NNFI = nonnormed fit index; CFI = comparative fit index.

the three-symptom cluster criteria had a total PCL score that was below 50.

Relations of Sociodemographic and Medical Variables With PTSD Symptoms

We conducted investigation of the relations of sociodemographic and medical variables with PTSD symptoms in two stages: using the PCL total score and using the four-symptom cluster model, because this model provided the best fit with these data. When using the PCL as a continuous measure for PTSD, we found no differences on the PCL total score for gender, employment status, education level (high school or less vs. some college or college degree vs. more than college), being married (vs. not being married), having a main partner, or self-identified racial/ethnic group (White vs. other). The two data sets did not have overlapping income categories (e.g., $25,000 or less in Sample 1 vs. less than $10,000 and $10,000–$19,999 in Sample 2). Thus, the relation of income was examined separately for the two data sets. In both data sets, income was not related to the PCL total score. There were no significant relations for the PCL total score and time since BMT/SCT or type of BMT/SCT (i.e., allogeneic vs. autologous).

Table 4
Factor Loadings and Factor Relationships

DSM–IV symptom (top) and factor (bottom)	Factor 1: Reexperiencing	Factor 2: Avoidance	Factor 3: Numbing	Factor 4: Hyperarousal
Standardized factor loadings (with standard errors)				
B1. Intrusive recollections	.58 (.05)			
B2. Distressing dreams	.22 (.03)			
B3. Flashbacks to cancer	.31 (.04)			
B4. Distress at reminders	.75 (.06)			
B5. Reaction to reminders	.43 (.04)			
C1. Avoid thoughts/feelings		.71 (.07)		
C2. Avoid reminders		.57 (.04)		
C3. Psychogenic amnesia			.56 (.08)	
C4. Anhedonia			.68 (.07)	
C5. Detached from others			.67 (.07)	
C6. Psychic numbing			.43 (.04)	
C7. Foreshortened future			.62 (.08)	
D1. Disturbed sleep				.76 (.09)
D2. Irritability/anger				.70 (.06)
D3. Concentration difficulties				.74 (.07)
D4. Hypervigilance				.59 (.07)
D5. Exaggerated startle				.64 (.06)
Factor correlations (with standard errors)				
Factor 1: Reexperiencing	— (.06)			
Factor 2: Avoidance	.70 (.05)	— (.10)		
Factor 3: Numbing	.70 (.05)	.58 (.06)	— (.09)	
Factor 4: Hyperarousal	.68 (.05)	.57 (.06)	.84 (.07)	— (.13)

Note. B1–D5 are *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV*) cluster letters and item numbers.

Univariate analyses revealed no differences between individuals meeting or not meeting the four-factor symptom model criteria of PTSD for the following variables: gender, employment status, education, being married, having a main partner, time since BMT/SCT, or type of BMT/SCT. However, those who met the four-symptom cluster criteria were younger at the time of BMT than were those who did not ($M = 32.11$ vs. $M = 38.70$, respectively), $t(234) = 2.20$, $p < .05$.

Discussion

The measurement of PTSD is critically important for the identification and treatment of this disorder. When choosing which measure of PTSD to use, researchers and clinicians need to consider a variety of criteria, including the construct validity of the measure. Contrary to the study hypothesis, the *DSM–IV* three-factor model of PTSD did not provide the best fit to the data, and therefore, the factorial validity of the PCL was not supported in this sample of cancer survivors. The four-symptom cluster model with reexperiencing, avoidance, numbing, and arousal provided the best fit. The expected relations among PTSD symptoms and sociodemographic characteristics were generally not supported, and no association was found for the investigated medical variables. These findings, their clinical implications, and study limitations are discussed.

The *DSM–IV* model was not found to be the best fitting model with the PCL data in the present study. Rather, out of a number of models tested, a four-symptom cluster model with reexperiencing, avoidance, numbing, and arousal provided the best fit. The fit was not improved with the addition of a higher order (i.e., umbrella) factor, although the fit indices (e.g., SRMSR and CFI) indicated that a four-symptom cluster model with a second-order factor also provided an acceptable fit. This result could be due to the poor factorial validity of the PCL, the conceptualization of PTSD in the *DSM–IV*, or the uniqueness of the posttraumatic stress syndrome found in this population (e.g., that cancer treatment is not a discrete event and that there is the possibility of recurrence; Green et al., 1998; Kangas, Henry, & Bryant, 2002).

Although the PCL was developed to match the PTSD symptoms outlined in the *DSM*, the incongruence between the *DSM–IV* symptom clusters and the symptom presentation found in the current study may be due to problems of measurement posed by the PCL (e.g., some items were kurtotic). In addition, although the four-factor model provided a reasonable fit with the data, there is controversy in the literature about indices' fit criteria (e.g., some suggest the CFI should be .95 or higher; Hu & Bentler, 1999). Thus, further psychometric and conceptual work may be needed with the PCL. However, on the basis of converging evidence, it is possible that the results found in the present study may not reflect a problem with the PCL but rather an alternative presentation of PTSD to that described in the *DSM–IV*. For example, with survivors of combat, L. A. King and colleagues (1998) found that the 4-first-order-symptom cluster model provided the best fit to the data generated with the CAPS. Thus, the present findings, in conjunction with prior research (D. W. King et al., 1998; L. A. King et al., 1998), suggest that a model with four-symptom clusters needs to be considered as an alternative symptom cluster presentation in the current psychiatric nomenclature. In light of this recommendation and echoing Asmundson and Taylor and their colleagues (Asmundson et al., 2000; Taylor, Kuch, Koch, Crockett, & Passey, 1998), disaggregating avoidance and numbing symptoms may necessitate generating an increased number of items for each of these symptom clusters to increase their reliability. Increasing the number of avoidance and numbing symptoms may also make it easier for a person to have sufficient symptoms to be identified as meeting either or both cluster criteria. Furthermore, future research needs to investigate what would be the best requirement for diagnosis. The predictive validity of the three- versus four-symptom cluster models, as well as different item requirements within each cluster, should be tested with an external criterion, such as the SCID. It is also important to investigate impairment in functioning for different symptom presentations.

Theoretical support for separating avoidance and numbing symptoms into the two clusters as suggested here also comes from the conception of prior theorists that avoidance and numbing are different constructs with intrusions leading to avoidance and arousal leading to numbing (Buckley, Blanchard, & Hickling, 1998; Foa, Zinbarg, & Rothbaum, 1992; Taylor et al., 1998). Longitudinal studies are best suited to helping understand these proposed relations. As noted by prior investigators (L. A. King et al., 1998; Ruscio et al., 2002), research addressing the underlying structure of PTSD should promote more accurate theoretical formulations about the nature of this disorder. Despite the empirical and theoretical support for consideration of the four-symptom clusters, we cannot rule out the conclusion that we found a four-symptom cluster model with the data as a result of the population we studied (i.e., cancer survivors). Replication of these results with other trauma populations is needed.

This study supported a relation between age and PTSD, with individuals who were younger at the time of their BMT/SCT being more likely to meet criteria for the four-symptom clusters. These results are consistent with prior trauma research suggesting a negative relation between a diagnosis of PTSD and age and prior cancer research suggesting a negative relation between PTSD symptoms and age at diagnosis (e.g., Kessler et al., 1995; Koopman et al., 2002). This study did not support the expected relations among PTSD symptoms and gender, education, marital status, and income. Although a meta-analysis of risk factors for PTSD showed an increased risk based on female gender and greater educational disadvantage, these effects tend to not be uniform across studies (Brewin, Andrews, & Valentine, 2000). In addition, a recent study with cancer survivors who had received a BMT/SCT did not find an association for gender or education and PTSD symptoms as measured by the PCL (Jacobsen et al., 2002). The lack of association of income and PTSD symptoms in the current study may have been a consequence of the incongruent income categories in the two samples. Further research with a large sample of cancer survivors may delineate the relations of sociodemographic indicators and PTSD.

The data from the current study indicated no associations for PTSD symptoms and the medical indicators investigated (i.e., time since BMT/SCT and type of transplantation). A longitudinal study in which the PTSD symptom course is investigated over the course of recovery from BMT/SCT is needed to address these relations adequately, because medical indicators may be associated with PTSD symptoms at different points in this process. Furthermore, although type of transplantation was associated with PTSD (i.e., trauma-related) symptoms in prior research with a subgroup of the sample for the current study (DuHamel et al., 2001), in that study the small number of individuals who had received an autologous

transplantation reduces the confidence in the finding that autologous transplantation was associated with more severe symptoms. The relation of PTSD symptoms and BMT/SCT medical indicators is an area for future research and should include alternative indicators. For example, medical complications or the adequacy of pain management during the course of transplantation may be more important as medical indicators for the development of PTSD. In addition, research with survivors of other traumas suggests that objective trauma severity may be less important than an individual's subjective severity ratings (Creamer, Burgess, & Pattison, 1992). The relative importance of objective and subjective trauma ratings with PTSD symptoms in cancer patients who have received a BMT/SCT deserves further study.

Clinical Implications

The application of different models of PTSD symptom clusters, or of combined alternative models, will affect who is identified as meeting symptom criteria for PTSD. In the current study, more cancer survivors met the three-symptom cluster criteria for PTSD than the four-symptom cluster criteria. Thus, the four-symptom cluster criterion is more stringent than the traditional *DSM–IV* criteria and more readily identifies those individuals who experience both avoidance and emotional numbing symptoms. If avoidance symptoms were critical to the diagnosis of PTSD in cancer survivors, these data would suggest that the current *DSM–IV* model overdiagnoses PTSD, as numbing symptoms are more frequent. Alternatively, if the goal of the *DSM–IV* is to ensure that the diagnosis of PTSD is inclusive of individuals with different symptom presentations, both symptom cluster criteria should be considered for inclusion in future revisions of the *DSM.* Perhaps the most important clinical implication of these data is that treatment may need to be tailored to the type of presenting PTSD symptoms. For example, individuals who are extremely avoidant may need exposure treatment. Thus, cancer survivors who meet the four-symptom cluster criteria may benefit most from CBT that includes exposure to thoughts and places the individual is avoiding, such as the BMT/SCT unit (Solomon, 1997). Future research needs to investigate whether there are different behavioral and affective concerns that manifest in the clinical expression of symptoms among individuals who have either or both avoidance and numbing symptoms. For example, individuals with both avoidance and numbing symptoms may have more severe anxiety or impairment in functioning. Such information would further inform the tailoring of treatment to differing symptom presentations. Consistent with the recommendations of L. A. King and colleagues (L. A. King et al., 1998), these data also suggest that in evaluating treatment gains, investigators should examine changes in both avoidance and numbing symptoms.

Study Limitations and Areas for Future Research

There are three study limitations that point to additional areas in need of future research. First, this study was conducted with a relatively homogeneous group of cancer survivors with regard to sociodemographic characteristics, and research is needed with more diverse sociodemographic groups. In addition, PTSD may not represent the most frequently experienced disorder among cancer survivors (Kangas et al., 2002). However, given the high prevalence of cancer in the United States, even if only a small percentage of survivors have PTSD, it represents a significant clinical problem. This study advances this area of research by suggesting that, similar to the results with other trauma survivors (e.g., with veterans; see D. W. King et al., 1998; L. A. King et al., 1998), there may be four symptom clusters or dimensions to PTSD in cancer survivors. Further research with a variety of trauma populations is needed and will add to the understanding of the dimensions of PTSD and better inform the current psychiatric nomenclature.

Second, this study included participants from a prior study in which a different factor structure for PTSD symptoms with the PCL was found. The results of the current study need to be replicated in a large, new sample of cancer survivors. In addition, the comparison of the fit of a model with the 4-first-order-symptom clusters with a similar model that also includes a second-order factor requires further investigation, because the latter model cannot be ruled out by the current results. Third, this study addressed only current PTSD symptoms keyed to cancer and its treatment. The symptom structure of PTSD in cancer survivors who have PTSD symptoms unrelated to their cancer and/or a comorbid psychiatric disorder is an area for future research.

Despite these limitations, on the basis of the study results and findings from prior research we conclude that the PCL meets Watson's five criteria. However, together with the findings from prior research, the current results indicate that the data from the PCL may not always map on to the *DSM–IV* PTSD symptom cluster model. One conclusion from these converging lines of evidence, and consistent with the recommendation of prior researchers (e.g., D. W. King et al., 1998), is that an alternative model of PTSD, in which the *DSM–IV*'s Cluster C symptoms are separated into avoidance and numbing clusters, should be considered for inclusion in the psychiatric nomenclature.

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Received May 1, 2003
Revision received January 13, 2004
Accepted January 28, 2004 ■